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INFORMATION HANDLING USER PRODUCTIVITY AND SUPPORT REPORT

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Executive Summary

EXECUTIVE SUMMARY

The purpose of this report is to describe the strategic planning goals for Agency Information Handling Systems in terms of User Productivity and Support for the period 1985-1989. This statement of goals was produced by an inter-Directorate Working Group.

The general goals for user productivity and support are:

1) To increase the productivity and efficiency of the Agency and

2) To improve the quality and timeliness of decisions and products.

From these general goals flow four specific objectives:

1) Provide most Agency employees with electronic work stations which are tailored to meet all of their information handling needs.

2) Improve life cycle support for information handling systems including initiation, development, maintenance, and replacement.

3) The Agency policy which places primary emphasis on identifying and meeting user needs should be clarified and promulgated to the working levels, i.e., the focus should be on using computers to help users do their work rather than as it is perceived - helping users work with computers.

4) Enhance organizational productivity by improving intra- and inter-organizational communications (electronic mail, teleconferencing, etc.) by improving resource management assistance to Agency managers (an integrated administrative support system) and by exploring and exploiting new technology in the area of decision aids.

The goals and objectives stated above reflect both solutions to current and projected problems and potential improvements offered by the developing technology. Taken together, they offer the Agency major improvements in productivity.

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I. Purpose

As part of the effort to develop the strategic plan for the Agency's Information Handling System, five working groups were established to address and define the strategic planning goals. The purpose of this report is to document the findings and conclusions of the Working Group on User Productivity and Support.

II. Scope

The Working Group's charge to consider the role of information handling systems in "user productivity and support" was one of great breadth and one that overlaps the topics of the other four working groups. Thus, one of the first tasks of the Working Group was to bound the topic. The area or areas selected had to hold the promise of great improvement in overall productivity of the Agency. Therefore, we did not consider it necessary to address a method for productivity measurement since the improvement in productivity will be intuitively obvious to management. Additionally, the Working Group had been given the direction that it was not to be constrained by costs but, rather, to address requirements. The Working Group focused on establishing a categorization of potential productivity - improving capabilities and on the enumeration of the attributes which systems should possess given the technology which will be available in the 1985-1989 time frame.

III. Approach

Prior to our first official meeting, some members visited a number of companies who offered information handling systems purported to increase user productivity. The visits were selected to provide some knowledge of industry accomplishments and plans in this area. The groups met on 30 November and 1 December to receive briefings from various Agency components about planned systems, to discuss the IHSA prepared Point Paper, and to determine what data ought to be collected from each directorate. During our three day data collection period, members interviewed a sampling of component managers from their Directorates to understand their perception of user needs in the 1985-1989 period. Directorate representatives proposed a statement of objectives based on their own experience and the ideas gleaned from the interviews. We met as a group again on 7 and 8 December to discuss our findings and draw up a candidate list of goals. After several iterations we have agreed on the key ideas expressed below.

IV. General Goals

The term "goal" is used here to mean the result or achievement toward which effort is directed. It implies that there is an ideal toward which we strive but may never fully realize.

The goals of information handling systems in terms of user productivity and support are:

    1. To increase the productivity and efficiency of the Agency and

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2. To improve the quality and timeliness of decisions and products.

In order to work toward these goals, we must develop an information handling capability which will enhance individual, group/organizational and functional productivity.

There is a very clear and strong perception on the part of many users of information handling systems in the Agency that the focus is improperly directed. Many feel that the focus should be on using computers to help users do their work rather than as it is perceived -- helping users work with computers. This perception, whether accurate or not, affects user productivity and needs to be addressed. The Agency policy which places primary emphasis on identifying and meeting user needs should be clarified and promulgated to the working levels. The policy must be supported by sufficient resources and an orderly plan for the life cycle support of systems.

The following three sections present the group's findings toward enhancing individual, group/organizational and functional productivity.

V. Supporting Individual Productivity

The single most important factor for improving individual productivity is:

> By 1989 to provide to most Agency personnel
> electronic workstations with certain basic characteristics
> (user friendliness, natural language, short response
> time, etc.), that will present to the user a single
> system environment and that will provide the
> needed information handling functions.

Users view programs, applications, and services accessed through the work station as an extension of the work station itself. Therefore, user requirements for better terminals and user interfaces translate into needs for much better requirements analysis, design, and functional interoperability of information handling services than the Agency has had in the past. Most users do not distinguish and should not have to distinguish between the operating systems, utilities, languages, data base systems, applications programs, and communications channels that make these things happen.

Users find it much too difficult to use today's terminals, interfaces, and services. Interfaces are cryptic and poorly documented. A common complaint is that systems seem to be designed for the convenience of programmers rather than users. Users have to obtain the services of programmers to do things which they could easily do (given the proper tools). Today, the user has to learn separate command languages for each system or application, or use more than one terminal.

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A new generation of terminals and user interfaces, electronic mail, and better data processing support, together could produce striking productivity improvements for many classes of users. Major productivity gains will occur when it is possible to redesign how jobs are performed because of improved information handling services. Thus, strategic ADP planning needs to be accompanied by process optimization at all levels in order to realize the potential for large productivity enhancements.

The requirements for a multi-function work station are given in the following three sections:

    A.   Basic Characteristics
    B.   System Environment
    C.   System Function Accessibility

First we describe the basic characteristics of the work station. Then we describe how the work station appears to the user. Finally we list the functions which the user can reach from the work station as an extension of the work station environment.

A.   Basic Characteristics

Requirements for work station characteristics apply both to the work station itself and the functions and services accessed through the work station. The most important characteristics are:

o Ease of use
o Ease of learning what work station capabilities are
  and how to use them
o Responsiveness in terms of feedback and response time
o Multi-media including text, graphics, and voice
o Nearby high quality hard copy output

Users have a very broad definition of ease of use. The work station should perform most parts of the task not requiring human judgment. The user should be able to communicate with the system rapidly and naturally relative to the task being done.

The need for such extensive special training represents a serious deficiency in new systems. Through a combination of simplifying procedures and processes, documentation, and help functions, systems should be self explaining, otherwise some level of CAI (computer assisted instruction) should be built into the system.

The work station must be responsive. Users have intuitive ideas of how long a function should take. Ideally, the work station should <u>consistently</u> respond in accordance with user expectations, and the response time should be appropriate for the function performed. The response time for "small" commands should be less than half a second. (Experiments have demonstrated real productivity gains when such response times are available.) On longer commands the work station should provide feedback on how the job is going. When a function is taking a long time to execute, the user should be able to do something else while waiting for it to be completed.

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Error messages and other forms of advisory output should be clear and complete - not requiring references to hardcopy documentation and manuals, and should be presented in non-data processing terminology. Error messages should provide alternatives to allow recovery and prevent repetition.

Text and graphic interaction are needed by almost all users. Text displays should include multiple type sizes, fonts, underlining, and inverse video as a minimum. Graphics should include line graphics, icons, and half tone shading. These graphics should be used to delimit multiple windows, command areas, and screen forms. These should be able to partially or completely overlap, appear, and disappear under user control. Graphics utilities should support creation of standard charts and graphs, organization charts, flow charts and free-form sketching.

For many users, it is essential to have a secure phone built into the work station. The work station should be able to place a call to another work station (or user) or a group of work stations. Some users will require voice messaging using the integral telephone.

. It should be possible to upgrade the basic work station by adding optional features. Examples of such features would include color graphics, multiple displays, special input devices, voice command, extra compute power, extra storage, added memory, and special peripherals. The ability to add optional features as required is vital.

Users should be able to create hard copy output in several forms and at locations where the outputs are to be used. High quality black and white hard copy, including graphics, should be available near any work station. Users should be able to route hard copy to registries, the Agency publications system and other places where it is needed rather than sending it through the mail. Direct production of color graphics and briefing aids should be available at convenient locations.

B. System Environment

The system environment for the electronic workstation should have the following characteristics:

o There should exist a common interactive environment for the electronic work station. Command languages menus, and displays must be standardized.

o Standard functions such as text editors, file managers, utilities, and graphics should be integrated so they they work together. This should make it possible to put together composite functions and specialized work environments without programming.

o The user should be able to access multiple systems (including non-Agency systems) through the use of a single multi-function terminal. It should be

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possible to access systems at different security levels
without risk of cross-talk/leakage from one
system to the next.

The system environment must be a single integrated information system -
extendable to meet all of the users information handling needs. It must be
engineered so that it is easy to learn and easy to use.

C. System Function Accessibility

A user should be able to realize all of his/her information handling
needs from a single work station. The following information handling
functions are needed to a significant number of Agency users:

- Electronic mail
- Office Automation
- Computer assisted instruction (CAI)
- Teleconferencing
- Personal computing
- Access to VM and MVS (or equivalents)
- Personal and group filing systems
- Access to central DBMS
- Knowledge-based systems
- Management support systems
- Administrative DB systems
- Access to outside nets and data bases

Electronic mail and office automation integrated into the multi-
function work station are the most important functions identified. The
system should provide a "what you see is what you get" editing and
formatting using the full graphics capabilities of the work station. Every
user should have electronic mail service. For security and need-to-know
reasons, each user must be closely tied into one or more job-oriented
networks (which could also serve as an extended office). All users would
be able to communicate via pseudonyms or user id's for crisis management,
coordinating office memoranda, etc. Special requirements would extend
beyond Headquarters. (DDO users would have electronic mail extending to
stations and bases. DDS&T would communicate with contractors.)

CAI should be used to help people learn how to use computer systems.
Several components expected to use CAI relying partly or entirely on OTE
for courseware development support. Other components expected to acquire
courseware developed outside the Agency. Therefore there is a need to use
CAI and develop courseware from a standard work station. There is also a
need to obtain and use courseware developed outside the Agency without
being constrained by the hardware or software implementation. (OTE expects
to make increased use of CAI for language training. They anticipate the
use of special hardware, therefore the standard work station might not be
involved.) An Agency plan for coordinating CAI acquisition and development
is needed.

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Teleconferencing from the standard work station would involve text and graphics (and on occasion, voice) being sent from one work station to one or more other stations. In this way a group of users could have a meeting without leaving their offices and finding a conference room, or traveling from outlying buildings to a central location. For some users there was not a clear distinction between teleconferencing and multi-media electronic mail which was regarded as a significant requirement.

Some Agency components will require the ability to do their own programming. The most used languages for personal computing are FORTRAN, PASCAL, BASIC, and APL. A number of technical analysts write small and medium scale FORTRAN programs. Economic analysts use APL, FORTRAN and a macro language called TROLL. Some support elements do their own BASIC programming. The overall extent and importance of user programming in the Agency is not well known. Do-it-yourself programming will have to be much more extensive and productive in the future given the expected chronic shortage of trained programmers. Improved tools for personal computing in a production group environment will have a major productivity payoff.

The multi-purpose workstation will have to be able to access all central computing facilities. The requirement exists for having a single terminal for accessing office automation, SAFE, ADSTAR, VM, MVS-Batch specialized systems such as TADS, as well as external systems.

Personal and group filing systems can add a great deal to individual and group productivity. The filing systems appearing in the personal computer market are examples of the tools which are needed. Such tools allow the user to specify a data file definition by designing one or more CRT menu pages. These systems provide query-by-example and have flexible report generating facilities. Whatever the approach, productivity is gained because users can design and use their own files with virtually no training and there is no drain on scarce programming resources.

The multi-purpose work station will need access to central Data Base Management System services. Even with extensive distribution of computation, there will be requirements for central data bases and data base dictionaries. Such access will result in improved productivity only if central data bases are fully integrated with other information processing services and present interfaces which are relevant to the user's work. This is one of the greatest possible productivity improvements when applied to administrative data bases relating to finance, budget, contract and project management, personnel, and security.

The Agency will be making operational use of knowledge based systems in the mid to late eighties. Given the rate of technological advance in knowledge engineering, we can conservatively predict that requirements for such systems will have very high priority in the mid-eighties. These systems will be written in unconventional programming languages, mostly dialects of LISP. Some of the work stations will be required to run these languages or special operating systems, or both, while they continue to support most attributes of standard work stations. In addition, it will be necessary for multi-purpose work stations to access special purpose

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computers running experimental or proprietary knowledge-based systems. The Agency's overall system architecture should make the installation of such computers almost a routine operation.

There is an increasing interest in the use of management support systems. These include management information systems (MIS), decision support, and planning systems. These systems should be highly integrated at the office, administrative and operational levels so that the decision maker can access all data relevant to the decision at hand. In some instances, the value of these tools will be enough to justify their use in stand-alone applications.

Some parts of the Agency have frequent needs to access external networks and data bases. The user should be able to configure the work station so that a trusted, unclassified subsystem can access outside sources and import data outside without any risk of leaking classified data to the outside. If security considerations do not allow this capability, then there will be a need for a <u>parallel</u> <u>unclassified</u> system of communications and terminals for this purpose which mimics many of the capabilities of the classified system. Also there will be a requirement for a means of sending files and messages of all types (data, text, programs, graphics, voice, etc.) from the unclassified system to the classified one so that the data appears ready-to-use in the classified system without any extra effort on the part of the user.

VI. Support Group/Organizational Productivity

To best enhance group/organizational productivity, the Agency should:

- o Improve resource management assistance to the Agency manager.

- o Provide electronic mail, teleconferencing and other improvements in group/organizational communications.

- o Explore and exploit the development of group decision aids.

From budget exercises to travel vouchers and training forms, resource management today, for most managers, involves many labor-intensive and/or complicated manual procedures. The development of an integrated administrative support system and additional decision support systems would greatly enhance the organizational productivity of the Agency.

The amount of time that it takes to coordinate meetings, find conference rooms, travel time, telephone'tag', etc. placed emphasis on the need for improvements in our existing communication capabilities. The loss of productivity caused by our inability to communicate effectively among the different groups, organizations within this agency and outside dictates the need for developing these tools. Additionally, other devices, such as electronic blackboards, that could help improve the decision process and/or support meetings and conferences should be explored for possible use.

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VII. SUPPORT FUNCTIONAL REQUIREMENTS

There is one particular area of productivity that is basic to the improvement of productivity through IHSs in all of the substantive and administrative areas of the Agency. This is the productivity aspect of the development process for the IHSs themselves and for the whole life cycle support of those IHSs.

A specific goal for this aspect of productivity is:

> The Agency must improve the life cycle support of
> IHSs in the 1985-1989 time frame.

From this goal statement, several more specific objectives were stated:

o Improve both the speed and the quality in the development
   of software application programs.

o Improve the various aspects of program development,
   from the requirements stage to the evolutionary
   replacement of the system.

o Training requirements have to be developed as an
   integral part of the system life cycle and not as
   an afterthought to the finished information system.

o As we improve the quantity and quality of software
   development, attention has to be paid to improving
   methods of converting the large amounts of non-digital
   data into digital format.

o The Agency needs to improve its ability to acquire
   systems from outside and interface them to existing
   systems so that we might take advantage of existing
   software products.

o Priorities need to be established, so that the more
   critical paths of information movement are supported
   first.

We first address the initial development of systems. There are several routes that the Agency can take in development of a computer-based system to perform some information handling function:

(1) It can be designed and developed by one of the Agency's
    professional ADP support organizations.

(2) It can be done by an outside contractor under the aegis
    of the component that will be using the system.

(3) The development can be done by one or more individuals
    in the organization that will use the system. Although

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their job titles will probably reflect the nature of
the organization they will, in fact, be full time analyst/
programmers for some period of time.

(4) Still another alternative route that might be taken
    in a large number of instances is dependent on the
    existence of suitably generalized "code generators"
    or "higher level applications languages". Given such
    system software the individual can easily create his
    own application system for the task at hand.

The same listing of routes that might be followed also can be applied to
the maintenance, modification and evolution of an application system
throughout its life.

The question now arises as to how the route followed bears on
productivity. The answer hinges on the increasingly severe (and industry-
wide) shortage of programming resources. The impact of this shortage must
be considered in light of the software development problems that presently
exist in the industry, and will continue through the 1980s without a major
change. Examples follow:

    1. sizable backlogs - often two to three
       calendar years of effort

    2. more than 50% of the ADP budget is developed
       to maintaining or rewriting old systems

    3. less than 20% of the ADP staff can be
       deployed for new development efforts

    4. programming costs are increasing and
       outpricing dollars spent for hardware

    5. a portion of developed software is
       never effectively used, often because of
       poorly stated requirements.

The time period 1985-89 will see an increasing proportion of staff
employees who have had substantial experience in using computers to solve
problems. These individuals will be not only willing but very able to
create the systems they need provided they have access to the tools to do
those jobs.

The Agency must put significant emphasis on improving applications
programming productivity. A combination of new software architectures and
programmer productivity tools supported by the multi-function work station
are very important The benefits would be realized through 1) increased use
of prototyping, 2) better productivity in programming tasks, and 3) the
ability of users to meet simple applications needs without programmer
assistance.

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In order to meet production and programming productivity needs, we should have the following software environment. Functions should coexist in an integrated command environment so they work together. Operating system and application programs should be built from common functional building blocks. Very high level languages package should be integrated with commands and functions making it easier to create tailored work environments.

VIII. Conclusions

Following the overall general goals described in the previous sections of this paper, the following conclusions were arrived at by the Working Group:

Goal 1   The Agency policy which places primary emphasis on identifying and meeting user needs should be clarified and promulgated to the working levels, i.e., the focus should be on using computers to help users do their work rather than as it is perceived - helping users work with computers.

Goal 2   By 1989, to provide to most Agency personnel electronic work stations with certain basic characteristics (user friendliness, short response time,...), that will present to the user a single system environment and that will have available the appropriate information handling functions.

Goal 2a   The most important characteristics of the electronic work station:

o Ease of use
o Ease of learning <u>what</u> the station does and <u>how</u> to use it
o Responsiveness in terms of feedback and response time
o Multi-media including text, graphics, and voice
o Nearby high quality hard copy output

Goal 2b   The objectives dealing with the system environment of the electronic work station:

o There should exist a common environment for the electronic work station. Command languages menus, and displays must be standardized.

o While building blocks should be common (command languages, editor, etc.), functions and equipment should be designed and packaged so that they may be integrated into the system for the purpose of structuring a tailored environment.

o The user should be able to access multiple systems through the use of a single multi-function terminal. The secure environment will prevent cross-talk/leakage from one system to the next.

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Goal 2c   The functionality of the electronic work station must
          include:

          - Electronic mail
          - Office Automation
          - Computer assisted instruction
          - Teleconferencing
          - Personal computing
          - Access to VM and MVS (or equivalents)
          - Personal and group filing systems
          - Access to central DBMS
          - Knowledge-based systems
          - Management support systems
          - Administrative DB systems
          - Access to outside nets and data bases

Goal 3   To best enhance group/organizational productivity, the planning
          objectives should be:

          o Improve resource management assistance to the
            Agency manager.

          o Provide electronic mail, teleconferencing and
            other improvements in group/organizational
            communications.

          o Explore and exploit the development of group
            decision aids.

Goal 4   The Agency must improve the life cycle support of IHSs in the
          1985-1989 time frame.

          More specifically, the requirements are:

          o Improve both the speed and the quality of develop
            ment in software application programs.

          o Improve the various aspects of program development,
            from the requirements stage to the evolutionary
            replacement of the system.

          o Training requirements have to be developed as an
            integral part of the system life cycle and not as
            an afterthought to the finished information system.

          o As we improve the quantity and quality of software
            development, attention has to be paid to improving
            methods of converting the large amounts of non-
            digital data into digital form.

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